

ORAL HYGIENE IN PATIENTS WITH FIXED PROSTHODONTIC RESTORATIONS

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Abstract

The aim of this study was to estimate the oral hygiene and gingival condition in patients with fixed prosthodontic restorations for a period of 3 months along with the oral hygiene instructions.

The study included 60 patients with fixed prosthetic appliances. Medical examinations of dental condition were carried out using basic diagnostic tools like dental mirror and periodontal probe. As well, we examine how factors, such as: age, gender, type of fixed dental prosthesis (single crown or fixed partial denture) and material (metal or porcelain fused to metal) are statistically associated with oral hygiene and gingival condition. Plaque and Gingiva index was taken according to the method of Silness and Löe. The examination was accomplished on the first dental visit, after 14 days and three months appropriately with the oral hygiene instructions. Statistical analysis was performed by using paired sample t-test from Statistical software SPSS for Windows version 23. A p-value < 0.05 was considered as statistically significant.

Our results confirmed that the Plaque and Gingiva index had higher values in the first visit than that found in the other periods. Patients with crowns had better oral hygiene levels compared to fixed dental prosthesis wearers. No statistical differences were found for type of material. Also, younger patients showed better hygiene levels than the older ones.

Our research showed that adequate education and instructions for oral hygiene maintenance lead to improved oral hygiene both in patients with single crown or fixed dental prosthesis.

Key words: *Fixed dental prosthesis, Gingival index, Oral hygiene, Plaque index.*

1. Introduction

Prosthetic rehabilitation of the stomatognathic system comprise substitution of a certain number of missing or harmed teeth in order to regain its lost function. The success of the therapy depends on many factors that should be considered when planning treatment. When we evaluate the success of prosthetic treatment, we are talking about the biological and structural durability of the restoration [1].

The negative effect of dental restorations on the gingiva has been a subject of many clinical studies. The most common complications from prosthodontic treatment are gingival inflammation and periodontal disease [2]. The pathological changes in periodontal tissues were primarily noticed when the margin of restoration had subgingival location [3]. This can be overcome by good oral hygiene maintenance. The motivation and ability of the patient to maintain good oral hygiene is with big importance on the long-term prognosis of the prosthodontic appliances and prevention of further complications [4].

Irregular and poor oral hygiene enable creation of a biofilm that will cause inflammation of soft tissues [5]. It is well known that dental plaque is the main cause of inflammatory reactions. By World Health Organization (WHO), dental plaque is defined as specific but highly variable structural entity resulting from colonization of microorganisms on tooth surfaces, restorations and other parts of oral cavity and consists of salivary components like: mucin, desquamated epithelial cells, debris and microorganisms, all embedded in a gelatinous extracellular matrix. Persistent inflammation of the soft tissue can cause an immune response followed by bone resorption. Maintaining good oral hygiene will lead to a significant reduction of the dental plaque accumulated on teeth and prosthodontic appliances [6].

This is particularly important in patients with fixed prosthodontic restorations where the physiological self-cleaning process is reduced and limited, thus facilitating plaque accumulation. Places most susceptible for plaque accumulation are crown margins and bridge connectors [1]. Therefore, patients who do not maintain good oral hygiene and clean their prosthodontic appliances insufficiently are more likely to have periodontitis problems [7, 8, and 9]. Hence, it is of great importance that the fixed prosthodontic appliance allows a suitable cleaning procedure.

The most common causes of poor oral hygiene are the lack of motivation of the patient, his weak dexterity and complicated restoration. If the patient is poorly motivated, they should be encouraged and educated by their therapist in order to improve their oral hygiene [10]. Many studies have confirmed that educating patients about the importance of oral hygiene leads to appropriate improvement of the patient's level of hygiene [11]. In patients with developmental disabilities and reduced dexterity, we need to educate their caregivers about the proper maintenance of oral hygiene [10]. If the patient is carrier of complicated restorations, additional hygienic techniques will also be required. If such treatment is carried out, some authors recommend the inclusion of an electric toothbrush in order to clear up difficult and inaccessible areas [5].

Many authors who have examined this issue indicate a poor level of hygiene habits in patients' carriers of prosthetic appliances [12, 13, and 14]. Other studies confirm that frequent and careful cleaning of teeth in patients with fixed prosthodontic restorations helps to maintain satisfactory oral hygiene [15].

Hence, the failure of prosthetic therapy, except that it can occur as a result of inadequate planning of the treatment itself and due to errors in the technical preparation of the restoration, the implementation of poor oral hygiene has a great impact. In order to protect the remaining teeth and to ensure the longevity of prosthodontic restoration, maintaining the proper oral hygiene in these patients is of great importance.

The aim of this study was to estimate the oral hygiene and gingival condition in patients with fixed prosthodontic restorations for a period of 3 months along with the oral hygiene instructions. As well, we examine how factors, such as: age, gender, type of fixed dental prosthesis (single crown or fixed partial denture), and material (porcelain fused to metal or acrylic veneered to metal) are statistically associated with oral hygiene and gingival condition.

2. Materials and Methods

The investigation was performed on a group of 60 patients who visited a private dental office in Kumanovo,

Macedonia and needed a prosthetic rehabilitation. The duration of the study was 3 months in the period of July 2016 to October 2016.

Patients with medical history of any acute or chronic diseases, such as: generalized periodontal problems, diabetes mellitus, autoimmune diseases, patients on drugs which cause hyperplasia of gums, were excluded from the research. The same exclusion criteria was as well for patients wearers of no correct gingival-adjacent restorations, overhung and unsuitable contour. Only patients whose therapy plan had predicted fixed prosthodontic restorations were selected. The patients included in the study were treated with 31 single crowns (SC) and 37 fixed partial dentures (FPD). From the total number, 39 subjects were female and 21 male. The age range was between 24 and 64 years. As to the material from which they were made, we noticed 43 ceramic-fused-to-metal (CFM) and 25 acrylic veneered to metal (AVM).

All respondents who participated in the study undergo on explanation and purpose of the research, as well as the possible risks and inconveniences.

After registration on general information and medical history for every patient, they undergo oral hygiene status examination. Medical examinations of dental condition were carried out using basic diagnostic tools like dental mirror and periodontal probe. The examination was accomplished on the first dental visit, after 14 days and three months appropriately with the oral hygiene instructions. Plaque and Gingiva index were taken according to the method of Silness and Løe [16]. For plaque identification four surfaces of the every present tooth were measured (mesio-buccal, disto-buccal, disto-lingual and mesio-lingual) and corresponding scores from 0 to 3 were given. In order to gain the plaque index for single tooth, the scores from the four surfaces of the tooth were added and divided by four. When we doubted between two values, we assigned the higher one.

The criteria for scoring of Plaque index were as follows:

0 - No plaque.

1 - A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque can be *in situ* only after the application of disclosing solution or by using the probe on the tooth surface.

2 - Moderate accumulation of soft deposit within gingival pocket or the tooth and gingival margin which may be seen by the naked eye.

3 - Abundance of soft matter within the gingival pocket and or on the tooth and gingival margin.

The criteria for scoring of Gingival index were as follows:

0 - Normal and healthy gingiva without inflammation, discoloration or bleeding.

1 - Mild inflammatory with minor insignificant changes in color, slight change in gingival texture and without bleeding on pressure.

2 - Moderate inflammation, glazing, erythema, edema and hypertrophy, followed by bleeding on pressure.

3 - Severe inflammation, bigger changes in color, erythema, redness and hypertrophy, bleeding spontaneously.

After the placement of the prosthodontic appliances, the patients were informed about their oral hygiene status level and educated for proper oral hygiene maintaining and their effect on the oral health. For a better result, the instructions were followed by a demonstration of models putting particular emphasis on the oral sites and pontics.

Statistical analysis was performed by using paired sample t-test from Statistical software SPSS for Windows version 23. A p-value < 0.05 was considered as statistically significant. For some categories of variables percentages were recorded as typical relative indicators.

3. Results and Discussion

In this study were included totally 60 patients. Distribution of the sample by age and sex are given in Table 1. From all subjects 18 patients were in the age group from 24 - 35 years; 31 patient were in the age group from 36 - 50 years and 11 patients were 51 - 64 years old.

Out of total 60 subjects, 39 were female and 21 male patients.

Distribution of the sample by material and type of prosthodontic appliances are given in Table 2. The patients included in the study were treated with 31 single crowns (SC) and 37 fixed partial dentures (FPD). As to the material from which they were made, we noticed 43 ceramic-fused-to-metal (CFM) and 25 acrylic veneered to metal (AVM).

Mean values of Plaque index (PI) and Gingival index (GI) depending on type and material of prosthodontic appliances are given in Table 3. Paired sample t-test for plaque and gingival index is given in Table 4. A p-value < 0.05 was considered as statistically significant.

After the hygienic instructions, the values of both indexes were reduced on the 14th day. At the next re-examination after 3 months, the values were mostly lower than initially, some of them were like in the beginning and only a small number of patients recorded worse values than the initial ones.

The difference of plaque index between first visit and 14 days after placement of single crown made by ceramic-fused-to-metal was statistically significant ($p = 0.0212$). Paired sample t-test for plaque index between 14th day and 3 months just like between 1st visit and 3 months were not significantly different ($p = 0.3736$; $p = 0.1332$).

Paired sample t-test for plaque index on single crown made by acrylic veneered to metal made by comparison on the mean values on the three check points show no statistically significant difference ($p = 0.2234$; $p = 0.3405$; $p = 0.2971$).

Statistically significant difference was noticed between the values for plaque index of fixed partial dentures made by ceramic-fused-to-metal using paired sample t-test after 14 days ($p = 0.0038$). Paired sample t-test after 3 months follow up for this kind of prosthodontic appliances were not significantly different ($p = 0.3575$; $p = 0.0930$). We gain similar results for fixed partial dentures made by acrylic veneered to metal and there were not statistically significant differences between the first visit, after 14 days and 3 months consequently ($p = 0.0824$; $p = 0.2914$; $p = 0.2914$).

The results we gain from the clinical examination of gingival index are given in Table 3 and Table 4. Paired sample t-test for gingival index of single crown made by ceramic-fused-to-metal were not statistically different

Table 1 Distribution of the sample by age and sex

Age	Male		Female		Total	
	N	%	N	%	N	%
24-35	6	33.3%	12	66.7%	18	100%
36-50	10	32.3%	21	67.7%	31	100%
51-64	5	45.5%	6	54.5%	11	100%
Total	21		39		60	

Table 2. Distribution of the sample by material and type of prosthodontic appliances

Material	SC		FPD		Total	
	N	%	N	%	N	%
CFM	22	51.2%	21	48.8%	43	100%
AVM	9	36%	14	64%	25	100%
Total	31		37		68	

Legend: SC - Single crowns; FPD - Fixed partial dentures; CFM - Ceramic-fused-to-metal; AVM - Acrylic veneered to metal.

($p = 0.2698$; $p = 0.3736$; $p = 0.3573$). We received similar results when the single crown was made by acrylic veneered to metal and the differences were not statistically significant ($p = 0.1732$; $p = 0.2234$; $p = 0.5$).

Paired sample t-test for gingival index between the first visit, after 14 days and 3 months follow up on fixed partial dentures made by ceramic-fused-to-metal showed that there is no significant association ($p = 0.2881$; $p = 0.5$; $p = 0.3328$).

The difference of gingival index between first visit and after 14 days on fixed partial dentures made by acrylic veneered to metal were statistically significant

($p = 0.0411$). No significant association was found for fixed partial dentures made by acrylic veneered to metal between first visit and after 3 months and 14 days and 3 months follow up ($p = 0.1677$; $p = 0.3356$).

The oral hygiene and condition of periodontal tissue of abutments has an important role in the long-term survival of crowns and bridges in the mouth. The influence and impact of oral hygiene in patients with prosthetic restoration presented in this study shows the importance of patient's dental education. Many authors advocate written and oral instructions for method and importance of oral hygiene in patients undergoing

Table 3. Mean values of Plaque index/Gingival index and type/material of prosthodontic appliances

Type/Material	Plaque index (PI); Gingival index (GI)	Plaque index/Gingival index Mean values		
		1 visit	14 days	3 months
SC CFM	PI	0.8636	0.6818	0.7272
	StDev	0,7743	0,6463	0,7025
	StError	0,1650	0,1377	0,1497
	GI	0.3636	0.2727	0.3181
	StDev	0,5810	0,4558	0,4767
	StError	0,1238	0,0971	0,1016
SC AVM	PI	0.7777	0.5555	0.6666
	StDev	0,8333	0,7264	0,5
	StError	0,2777	0,2421	0,1666
	GI	0.5555	0.3333	0.5555
	StDev	0,7264	0,5	0,7264
	StError	0,2421	0,1666	0,2421
FPD CFM	PI	0.9523	0.5714	0.7619
	StDev	0,6690	0,6761	0,4364
	StError	0,1459	0,1475	0,0952
	GI	0.3333	0.2857	0.2857
	StDev	0,4830	0,4629	0,4629
	StError	0,1054	0,1010	0,1010
FPD AVM	PI	0.8571	0.7142	0.7857
	StDev	0,7703	0,6112	0,6992
	StError	0,2058	0,1633	0,1868
	GI	0,5	0,2857	0,4285
	StDev	0,7595	0,4688	0,5135
	StError	0,2029	0,1252	0,1372

Legend: SC - Single crowns; FPD - Fixed partial dentures; CFM - Ceramic-fused-to-metal; AVM - Acrylic veneered to metal.

Table 4. Paired sample t-test; $p < 0.05$ significant; $p > 0.05$ not significant

		P value		
		1 day/14 day	14 day/3 months	1 day/3 months
SC CFM	PI	0.0212	0.3736	0.1332
	GI	0.2698	0.3736	0.3573
SC AVM	PI	0.2234	0.3405	0.2971
	GI	0.1732	0.2234	0.5
FPD CFM	PI	0.0038	0.3575	0.0930
	GI	0.2881	0.5	0.3328
FPD AVM	PI	0.0824	0.2914	0.2914
	GI	0.0411	0.1677	0.3356

Legend: SC - Single crowns; FPD - Fixed partial dentures; CFM - Ceramic-fused-to-metal; AVM - Acrylic veneered to metal.

prosthetic treatment. They emphasize that this is of great importance for the successful treatment and longevity of prosthetic construction [17, 18].

There are opposing results on this topic in the literature. Some studies have suggested that in carriers of prosthetic appliances with inadequate oral hygiene was registered increased plaque accumulation which has a negative impact on the periodontal tissue [19, 20]. Tejchman *et al.*, in their study concluded that the patients using the prostheses with precise elements require individual hygiene instruction [17]. According to some other studies, no statistically significant difference in plaque and gingival index was found in patients with this type of prosthetic restorations [21].

In this study, the values of plaque and gingival index in patients with prosthetic appliances were higher at the first visit than after 14 days and 3 months respectively. In most patients, the score of plaque and gingival index during control examinations were 0 and 1, suggesting that they maintained a good level of oral hygiene. It confirmed that a good education and giving appropriate instructions for proper maintenance of oral hygiene among this type of patients has a major impact on the plaque accumulation [22].

In our study, patients were informed about their oral hygiene status level and educated for proper oral hygiene maintaining and their effect on the oral health, after the placement of the prosthodontic appliances. The instructions included a demonstration on models with especially paid attention on high risk spots. Reinstructions and reexaminations were done after 14 days and 3 months.

We recorded a decrease in values for plaque and gingival index on the first control after 14 days. At the next reexamination after 3 months, the values were lower than initially, some of them were like in the beginning and only a small number of patients recorded worse values than the initial ones.

This points to the fact that patients had greater motivation for maintaining and improving oral hygiene at the start of the examination. Based on our investigations we can conclude that the motivation was higher at the beginning, therefore the values of plaque index in both single crowns and fixed partial dentures made by ceramic-fused-to-metal, after 14 days were statistically significant ($p = 0.0212$; $p = 0.0038$). Some authors suggest that the accumulation of plaque is greater in fixed partial dentures compared to single crowns [23]. The reason is the difficult access of dental brushes in certain places in bridge structures and that they require more motivation and time for adequate removal of the plaque. Our examination coincides with these results. Even though we had a statistically significant improvement in single crowns, it was much higher in fixed partial dentures.

As far as prosthodontic restorations made by acrylic veneered to metal the improvement was not statistically significant. There was also no statistical significance in the re-examination after 3 months in any prosthetic restoration.

In relation to the gingival index, statistically significant improvement is also registered after 14 days but only in the fixed partial dentures made by acrylic veneered to metal ($p = 0.0411$).

As regards age, the values of plaque and gingival indexes were better in younger patients, although this was not statistically significant. We also found lower values in females. We believe that this is due to the higher motivation of younger patients and their better general health condition.

As an important factor for improving oral hygiene, it can be assumed that adequate education and the additional use of interdental brushes is appropriate. Results obtained from other studies indicate that the daily use of interdental brushes has greater efficacy in plaque removal [20], especially from the proximal surfaces of the tooth comparing when using only brushes in combination with a dental floss [24]. From here it is seen the great influence of the therapist in educating patients on a healthy lifestyle because most of the people consider the medics as the most reliable source of information [25].

Prosthetic appliances without correct gingival-adjacent and over contoured morphology have a big influence that contributes to poor maintenance of oral hygiene [26], and consequently connected with inflammation of periodontal tissue [27]. Therefore, in order to standardize the samples in our study, they were excluded from the examination and so have no effect on the finally result.

Other studies have confirmed that insufficient oral hygiene is an important factor for the occurrence and development of inflammatory changes of the gingival tissue under prosthetic restoration [28]. However, the period of our research, as well as the number of respondents, was not sufficient to bring credible conclusions. According to many studies, the time of use of crowns and fixed partial dentures has a significant effect on the maintenance of oral hygiene and the corresponding response to oral mucosa [29, and 30].

Prosthetic appliances can be made of different materials. In our examination two types were used, as follows: porcelain-fused-to-metal and acrylic veneered to metal. In this study we obtained statistically better results in the plaque index for porcelain-fused-to-metal restorations, but they were registered only on the first reexamination. After 3 months, the difference was not statistically significant.

As regards the gingival index, statistically significant differences occurred only in fixed partial dentures made of acrylic veneered to metal on the reexamination after 14 days. All other parameters did not show statistical significance.

According some authors [31, 32], the material has little effect on the plaque accumulation and gingival reaction. Our examination is consistent with this, because there is no continuity in statistical significance. However, we should take into consideration that the period of our examination was too short to make reliable conclusions. It should be noted that there are studies reporting that the level of plaque accumulation and the state of the gingival mucosa differ between various materials [33, 34]. However, the time of use of prosthetic restoration significantly influenced on the level of oral hygiene [30]. Therefore our next studies should include a larger number of subjects as statistical analysis would provide more reliable results and, of course, the length of the research should be at least five years as a critical period for this type of prosthodontic appliances.

4. Conclusions

- Although many studies confirm that prosthetic restorations have a negative effect on oral health, our research showed that adequate education and instructions for oral hygiene maintenance lead to improved oral hygiene both in patients with single crown or fixed dental prosthesis.

- Considering the type of the material used for prosthodontic appliances, both porcelain-fused-to-metal and acrylic veneered to metal showed no statistically significant difference.

5. References

- [1] Milardovic O. S., Viskic J., Stefan S., Rener S. K., Vojvodic D., Mehulic K. (2012). *Oral Hygiene and Gingival Health in Patients with Fixed Prosthodontic Appliances - A 12-Month Follow-Up*. Coll. Antropol. 36, 1, pp. 213-220.
- [2] Basnyat K. S., Sapkota B., Shrestha S. (2015). *Oral Hygiene and Gingival Health in Patients with Fixed Prosthodontic Appliances - A Six Month Follow-up*. Kathmandu Univ. Med. J. 13, (52), pp. 328-332.
- [3] Valderhaug J., Heløe L. A. (1977). *Oral Hygiene in a Group of Supervised Patients with Fixed Prostheses*. J. of Periodonto., 48, (4), pp. 221-224.
- [4] Louropoulou A., Slot D. E., Weijden F. V. (2015). *Influence of mechanical instruments on the biocompatibility of titanium dental implants surfaces: A systematic review*. Clin. Oral Implants Res. 26, (7), pp. 841-850.
- [5] Cagna D. R., Massad J. J., Daher T. (2011). *Use of a powered toothbrush for hygiene of edentulous implant-supported prostheses*. Compend. Contin. Educ. Dent., 32, pp. 84-88.
- [6] Taraszkievicz-Sulik K., Gołębiewska M., Lewkowski A., Kamińska I., Kalinowska M., Grycz M., Litwin K. (2012). *Hygiene of fixed prosthodontic restorations*. Prog. Health Sci., 2, 2, pp. 103-106.
- [7] Ramage G., Tomsett K., Wickes B. L., Lopez-Ribot J. L., Redding S. W. (2004). *Denture stomatitis: a role for Candida biofilms*. Oral Surg. Oral Med. Oral Pathol. Oral Radio. Endod., 98, (1), pp. 53-59.
- [8] [Jeganathan S., ChongLin C. C. (1992). *Denture stomatitis - A review of the aetiology, diagnosis and management*. Austral. Dent. J., 37, (2), pp. 107-114.
- [9] Grimound A. M., Marty N., Bocquet H., Andrieu S., Lodter J. P., Chabanon G. (2003). *Colonization of the oral cavity by Candida species: Risk factors in long-term geriatric care*. J. Oral Sci., 45, (1), pp. 51-55.
- [10] Ahuja S., Wicks R., Selecman A. (2016). *Fabrication of new restorations with a consideration of oral Hygiene*. J. Indian Prosthodont. Soc., 16, pp. 307-310.
- [11] Ribeiro D. G., Pavarina A. C., Giampaolo E. T., Machado A. L., Jorge J. H., Garcia P. P. (2009). *Effect of oral hygiene education and motivation on removable partial denture wearers: longitudinal study*. Gerodontology, 26, (2), pp. 150-156.
- [12] Rusiniak-Kubik K., Gawor E., Godlewski T., Mierzwińska-Nastalska E. (1995). *Hygiene status of geriatric patients' prostheses from Warsaw (in Polish)*. Protet. Stomatol., 45, (5), pp. 285-259.
- [13] Mikołajczyk A., Klukowska Z. (1988). *Problems of oral hygiene in patients using partial prostheses (in Polish)*. Protet. Stomatol., 38, (6) pp. 249-252.
- [14] [14] Tejchman H., Prośba-Mackiewicz M. (1991). *The role of hygiene in prosthetic treatment (in Polish)*. Protet. Stomatol., 41, (6), pp. 261-266.
- [15] Belser U. C., Strub J. R., Buser C. E. (1980). *Effect of controlled oral hygiene procedures in patients with fixed prostheses*. SSO Schweiz Monatsschr Zahnheilkd, 90, (5), pp. 484-494.
- [16] Silness P., Loe H. (1964). *Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition*. Acta Odontol. Scand., 22, pp. 121-135.
- [17] Tejchman H., Prośba-Mackiewicz M. C. (2004). *Assessment of oral hygiene status and prosthetic restorations with precise retention elements based on clinical trials and stained bacterial plaques. The role of hygiene in the prosthetic treatment of patients - Part I. (in Polish)*. Protet. Stomatol., 54, (6), pp. 384-387.
- [18] Sulkowska M., Szymczak J. (1995). *Evaluation of Caries test and Plaque-test (in Polish)*. Mag Stomatol., 3, pp. 28-31.
- [19] Stipetic J., Ivanis T., Celebic A., Catovic A., Kuna T., Segovic S. (1999). *Oral Hygiene and Gingival Health in Patients with Temporarily Fixed Bridges*. Acta Stomatol. Croat., 33, pp. 199.
- [20] Jared H., Zhong Y., Rowe M., Ebusutani K., Tanaka T., Tanaka N. (2005). *Clinical trial of a novel interdental brush cleaning system*. J. Clin. Dent., 16, (2), pp. 47-52.
- [21] [21] Valderhaug J., Ellingsen J. E., Jokstad A. (1993). *Oral hygiene, periodontal conditions and carious lesions in patients treated with dental bridges. A 15-year clinical and radiographic follow-up study*. J. Clin. Periodontol., 20, (7), pp. 482-489.

- [22] Roscher T., Rosing C. K., Gjermo P., Aass A. M. (2004). *Effect of instruction and motivation in the use of electric and manual toothbrushes in periodontal patients. A comparative study.* Braz. Oral Res., 18, pp. 296-300.
- [23] Lorato D. C. (1975). *Effect of artificial crown margin extension and tooth brushing frequency on gingival pocket depth.* J. Prosthet. Dent., 34, (6), pp. 640-643.
- [24] Kiger R. D., Nylund K., Feller R. P. (1991). *A comparison of proximal plaque removal using floss and interdental brushes.* J. Clin. Periodontol., 18, (9), pp. 681-684.
- [25] Tandara A., Marin M., Preoteasa E., Cuculescu M. (2011). *Oral hygiene habits in a group of 44 Romanian patients with dental implant prosthetics.* Rom. J. Oral Rehabil., 3,(3), pp. 82-93.
- [26] Silness J. (1970). *Periodontal conditions in patients treated with dental bridges: The relationship between the location of the crown margin and the periodontal condition.* J. Periodontal Res., 5, pp. 225-229.
- [27] Knoernschild K. L., Campbell S. D. (2000). *Periodontal tissue responses after insertion of artificial crowns and fixed partial dentures.* J. Prosthet. Dent., 84, (5), pp. 492-498.
- [28] Tolboe H., Isidor F., Budtz-Jørgensen E., Kaaber S. (1987). *Influence of oral hygiene on the mucosal conditions beneath bridge pontics.* Scand. J. Dent Res., 95, (6), pp. 475-482.
- [29] Dautović-Kazazaić L., Redžepagić S., Ajanović Gavranović A., Strujić S. (2010). *Periodontal Evaluation of Patients with Ceramic Fused-to-Metal and Acrylate Fused-to-Metal Crowns over a Period of 1 to 5 Years.* Acta Stomatol. Croat., 44, (1), pp. 34-46.
- [30] Jameson L. M. (1979). *Comparison of the volume of crevicular fluid from restored and nonrestored teeth.* J. Prosthet. Dent., 41, pp. 209-214.
- [31] Reitemeier B., Hansel K., Walter M. H., Kastner C., Toutenburg H. (2002). *Effect of posterior crown margin placement on gingival health.* J. Prosthet. Dent., 87, pp. 167-172.
- [32] Christensen G. J. (2009). *Porcelain-fused-to-metal versus zirconia-based ceramic restorations.* J. Am. Dent. Assoc., 140 pp. 1036-1039.
- [33] Olsson J, van der Heijde Y, Holmberg K. *Plaque formation in vivo and bacterial attachment in vitro on permanently hydrophobic and hydrophilic surfaces.* Caries Res. 1992;26(6):428-33.
- [34] Baucic I., Baucic M., Stipetic J., Komar D., Mehulic K., Bozic D., Klaic B., Celebic A. (2002). *Screening of fixed prosthodontic dentures after five years of use in relation to material and construction.* Coll. Antropol., 26, (2), pp. 673-679.